"AKSHI" - AN ASSISTIVE DEVICE FOR VISUALLY IMPAIRED

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Abstract: Visual impairment means loss in vision of a person such that it requires for an additional support due to significant limitation of visual capability .Visually impaired people face many problems in day to day life but major challenge is independent navigation and mobility. Moreover, visually disabled people are dependent and need assistance from other persons. In this paper, a real time device is proposed and implemented which will provide guidance in the form of vibrations through different sensors for both indoor and outdoor environments making navigation more safe and secure.

Keywords- AKSHI, Emergency facility Visually Impaired, Walking Stick.

Introduction: In today's era, approximately 37 million people across the globe are visually impaired, out of which over 15 million are from India[1]. The main causes of visual impairment are due to some disease, trauma or degenerative conditions that cannot be corrected by conventional methods like refractive correction or medication. The world is developing day by day but blind people still have blackness around them. So, it is difficult for the differently abled to live and move around in most of the places. Especially for those who have no visual information, experience a lot of difficulties in day to day life. These people face a lot of problems in understanding their surroundings and environmental conditions. Many daily life objects become obstacles to them. Although they use a stick to acquire this information, it is hard for them to move around[3].A lot of research has been done to provide navigation to the visually handicapped and impaired users both indoors and outdoors. There are various technologies available to the visually impaired to help them navigate, they all either limit the freedom of the user, or are too expensive. Therefore, a complete guidance system is needed for visually impaired people to make them independent and improve the quality of life. In this paper, the proposed system consists of Obstacle detection module for calculation of distance between obstacle and user, Water detection module for water level detection in rainy season, Feedback module to alert the blind users , Emergency services module to provide help in case of exigency, RF remote module to find the location of stick whenever misplaced by user. The rest of the paper is organized as follows. Section II discusses in detail about the existing devices and presents the gaps or shortcomings in them. Section III presents the proposed solution. Section IV shows the implementation. Section V presents the future work and concludes the paper.

Related work: Vision is the most important part of human physiology as 83% of information human beings get from the environment is via sight. Numerous attempts have been made in the society to help the blind. Some of the traditional systems are described below:

Traditional Systems

1. **Long Cane:** It is a mobility tool which can be used to detect objects which come in the path of a user. The length of the cane depends upon the height of user[5].
2. **Guide Cane:** It is a shorter in length and extends from the ground floor to the waist of the user . It has a limited mobility function but can be used diagonally across the body for warning the user of obstacles ahead thus giving protection[3].
3. **Identification Cane:** The ID cane , also called as the symbol cane is used to alert others about the bearer's visual impairment. It is usually shorter and lighter than the traditional long cane, with use as a tool for mobility[3].
4. **Support Cane:** It is primarily designed to provide physical stability to the visually impaired user. It also works as a means of identification by virtue of its colour. This cane has limited potential as a mobility tool[3].
5. **Kiddie Cane:** This cane works similar to the adult's Long Cane but is designed specifically for use by children[3].

Some assistive devices are discussed below:

Assistive Technology Systems

Ultracane: The Ultracane is equipped with a narrow beam dual range, ultrasound system which provides a 100 percent hazard protection envelope in front and forward of the head and chest of the user [7]. Two ultrasound transducers provide range data on the closest potential hazards, like plants, people, hanging branches which makes the ultracane equally usable on the street as in interior spaces. The extra information provided by the ultracane allows the user to make decisions in advance about obstacles in their path giving them more independence and confidence.

Guide Cane: The Guide Cane is designed to help the visually impaired users navigate safely and quickly among obstacles and other hazards[8]. It is used like white cane but is considerably heavier than the white

cane, because it uses a servo motor. The wheels are equipped with encoders to determine the relative motion. The servo motor is controlled by the in-built computer which can steer the wheels towards the left and right relative to the cane. To detect obstacles, the Guide Cane is equipped with ten ultrasonic sensors. A mini joystick which is located at the handle allows the user to specify the desired direction of motion[3].

"Smart Vision": Active vision for the blind" has been developed to allow autonomous navigation of people with disability in both Indoor and outdoor environments[9]. The technologies used includes computer vision using a stereo vision system; RFID tags for location error minimization; GPS, for outdoor positioning; location by tri-lateration of signals from Access Points (APs)[10] , for indoor positioning; a geographic information system (GIS) data from both in indoor and outdoor environments[11].

Smart Cane(2014): It is an electronic travel aid which fits on top fold of white cane. It helps detecting objects which are knee above and hanging obstacles[14].

The following table represents the limitations of existing devices.

TITLE	LIMITATIONS
White Cane	• Difficult to Navigate in Unknown Environment • Feedback signal is low. • Mainly used in Indoor Purpose
IR Sensor	• Difficult to locate wide opening. • Don't produce good result in presence of light.
RFID Technique	• Corrupt data transmission either by absorption or by ambient reflection of signal. • Restrict freedom of design.
Palm Sonar	• Can't be attached with or on the cane.
Roshni	• Only for indoor navigation and does not give warning feedback.

Proposed work: This paper proposes a dedicated device for the visually impaired people which would be used for performing mobility tasks using assistive aids. "AKSHI" is an innovative device designed for visually disabled people for improving navigation. This will be an advanced blind cane that allows visually challenged people to navigate with ease using advanced technology. It is integrated with ultrasonic sensor along with water sensing. The proposed project uses ultrasonic sensors to detect obstacles using ultrasonic waves. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates if the obstacle is close enough. If the obstacle is not that close the circuit does nothing. If the obstacle is close the microcontroller sends a signal to vibrate the vibration motor. It also detects and sounds a buzzer if it detects water and alerts the user. The emergency module allows the blind to press a button in case of emergency which will send an alert message and location to a predefined number with the help of GSM and GPS. The system also incorporates the feature of locating the cane if it is misplaced. A wireless RF based remote is used for this purpose. Pressing the remote button sounds a buzzer on the stick which helps the blind person to find their stick. Thus this system allows obstacle detection, emergency services as well as finding stick if misplaced by visually disabled people. The following flow chart describes the working of the system.

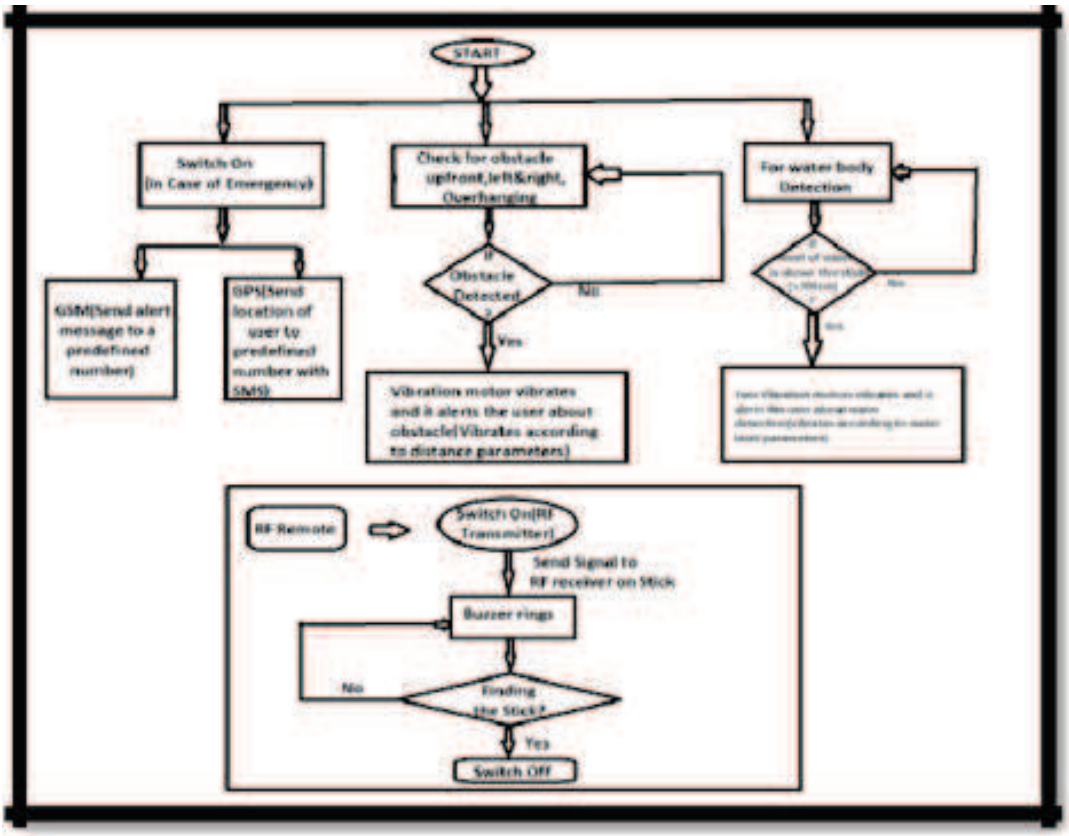

Fig.1 Flow Chart Diagram

The working methodology of project is divided in three modules. The first module is the Emergency module which will work when the user presses the switch in case of an emergency. Second Module is the Obstacle detection module, in this module the obstacles are detected in the path of the user. The third module will be the Water Detection Module in which the water body patches are detected .The second and third module will work in parallel. A RF Remote will be used to find the location of stick whenever it is misplaced by the user.

Implementation: This section describes the implementation of various modules of AKSHI that have been accomplished. The modules are interfaced with an Arduino Board with ATmega328. Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button[18]. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform[19].

Communication Interfaces: Communication interface such as GPS is used which correctly sends the position of user to the predefined number. The GPS module obtains the precise location by parsing received GPS signal. The GSM module can send the information out by a SMS (Short Message Service) message, including real time position of the blind user. Further, an emergency switch will be used to send the location of user by sms. This will keep the user safe in exigency.

Sensors Interfacing: 1)Ultrasonic Sensor: An Ultrasonic Sensor is used for obstacle detection. It emits an ultrasound at 40 KHz which travels through the air and if there is an object or obstacle on its path it bounces back to the module. When the user starts to navigate in known or unknown environment this will help to detect the obstacles and send a vibration feedback with the help of vibration motors to alert the blind user. This module acts as a security feature for the blind user.

2) Water Sensor: It is used to detect the water body patches in the path of a blind user. When the circuit of sensor comes in contact with water, the circuit gets complete and current starts flowing through it and provides voltage output to the control and thereby indicates the presence of water.If the level of water is high, vibration motors are triggered to alert the blind person about water body patches.

Input/output Interfaces: I/O interfaces such as vibration motor are used to give vibration alerts to the blind user about obstacle and water body patch detection. Buzzer is placed on stick with RF receiver. The RF transmitter sends the signal to RF receiver and it triggers the buzzer to ring. So, it is used to find the location of stick whenever misplaced by user. The following Figure 2 shows the architecture of the device with various input/output peripherals, sensors and communication modules.

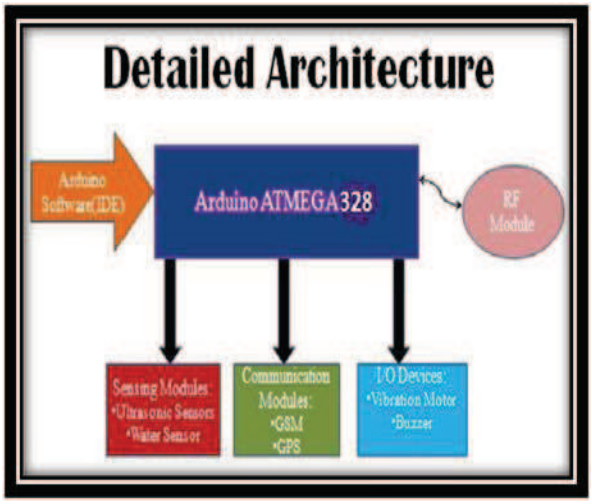

Fig.2 Architectural Diagram

The Figure 3 shows the interfacing of Ultrasonic and Water sensor with Vibration motors which works as an obstacle and water detection system. As the obstacle is detected, the vibration motor starts automatically and gives vibration alerts to the blind user. Moreover, when water comes in contact with the water sensor then two vibration motors are triggered and give alerts to the blind user.

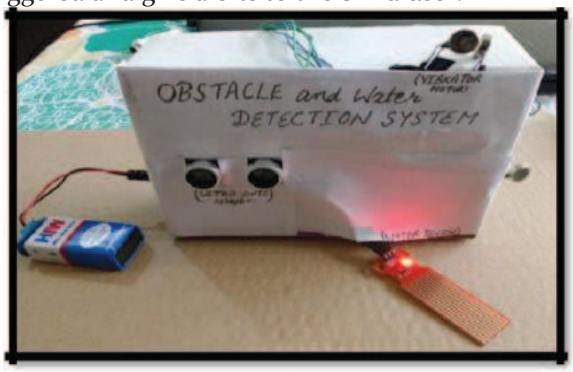

Fig.3 Interfacing of Ultrasonic and Water Sensor along with Vibration Motors

The Fig.4 shows the interfacing of GPS module and GSM module along with Switch which works as a panic button to user in case of emergency.

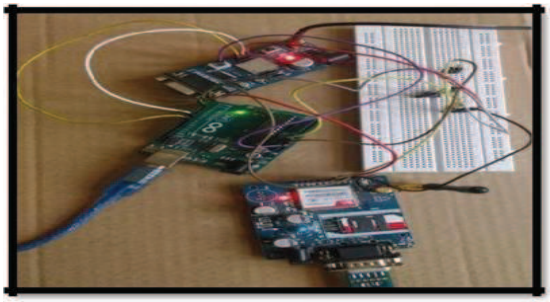

Fig.4 Interfacing of GSM and GPS along with Push Button

The Fig.5 shows the result of first module i.e. emergency situation, when the user presses the switch, the location of user is sent via message to a predefined number.

Fig.5 Result of GSM and GPS along with Push Button

The Fig.6 shows the interfacing of RF Module with Buzzer which is used to find the location of stick whenever misplaced by user.

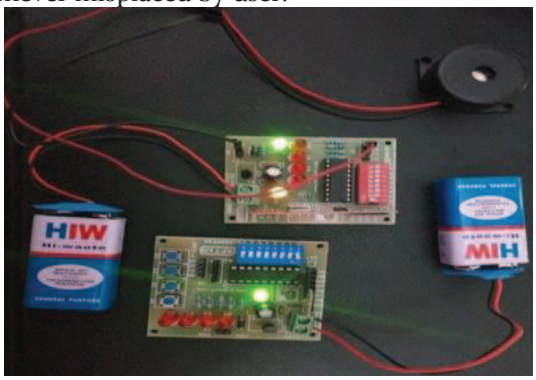

Fig.6 Interfacing of RF module along with Buzzer

Conclusion & future scope: In this paper, a prototype of a mobility aid "AKSHI" for visually impaired people is presented. AKSHI is able to overcome some limitations of the existing mobility aids .It demonstrated greater effective and simplistic use by the user than the existing systems. AKSHI is an integrated guidance system for the visually impaired to ensure that they have a guide for walking on the correct path by making them feel safe, secure and comfortable. The obstacle and water detection modules work in parallel to guide the blind person. A

distress signal indicating the user needs help is incorporated via the SOS feature. A RF remote to find the location of stick whenever misplaced by user is also provided.

This project will help to reduce dependency on sighted assistance thereby empowering the visually challenged, also it is much cheaper and 'smarter' than traditional ones. Future work will concentrate on:

- All sensors or system can be designed on a belt.
- A handsfree based voice operated system can be built for indoor and outdoor environment.
- Power supply management can be optimized.

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